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THESIS

AN ANALYSIS OF NAVAL OFFICER ACCESSION SUPPLY: HISTORICAL FACTORS AND FUTURE TRENDS

by

Franz-Josef Lenssen

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In a second step, the basic officer supply models are estimated for specific officer programs such as nuclear officers, nurses, medical officers, and the entire medical corps. The estimated regression equations for the separate programs were not sufficiently robust to allow accurate forecasting. Possible causes for the inadequate results are discussed.

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An Analysis of Naval Officer Accession Supply: Historical Factors and Future Trends

by

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I. INTRODUCTION

A. BACKGROUND

Demographic trends show a steady decline of the youth population in the United States through 1996, followed by a moderate increase until 2010. This population decrease is having a major impact on the labor force. For example, it is already affecting the military, and is expected to make recruiting increasingly more difficult over time. Part of the problem for the military relates to the fact that all four branches of service must compete against each other in recruiting high quality personnel; and, in addition, they all are faced with intensified competition from a growing, well-paying industry. The question of officer supply becomes more and more important under these circumstances. This is still true with possible troop reductions, which will result in reduced demand for officer candidates, since the focus is on high quality applicants with technical training.

The Navy Recruiting Command (NRC) establishes the annual recruiting goals for all Navy officer programs, based on the total manpower requirements for each of these programs. Officer recruiting is divided into over 40 separate programs, such as nuclear, medical, minorities, etc. NRC distributes the respective shares over the six Navy Recruiting Areas (NRAs), and the Area commanders then assign the goals per program to the 41 Navy Recruiting Districts (NRDs). Market

share and recruiter share are the major factors that determine the goal distribution. Recruiting conditions, however, are unlikely to be equal all over the United States, and some geographic areas might fail in recruiting for some programs while others could easily accomplish higher goals for those same programs. Thus, establishing the right goals for each officer program and NRA will make recruiting more effective. This could become especially important as competition for the supply of high quality college graduates grows and, as is likely, recruiting sources become increasingly scarce.

B. OBJECTIVES

To be able to set realistic goals for officer recruiting, the Navy should have the capability to forecast future supply conditions by local geographic areas. The objective of this study is to develop a supply model to predict future officer accessions[1] and possible shortfalls. This requires that political, demographic, and economic factors and trends important to officer recruitment be identified and analyzed.

The announced troop reductions, defense budget cuts, and the geopolitical changes in the Soviet Union and Europe will affect both the demand of and the supply for military personnel. Economic factors and trends, as well as demographic trends are also important for recruiting, especially for

[1]The term "accession" refers to those recruited and actually entering the Services.

those programs having difficulties in meeting their recruitment goals, such as minorities, medical, and nuclear officer programs.

This thesis will attempt to collect historical data--broken down by NRD and NRA--on accessions, recruiters, and goals from NRC. Recruiting data will be combined with local labor market and demographic data, in order to construct an officer accession data base. The purpose of this data base is to provide a cross-sectional, time series, or pooled sample suitable for analyzing officer manpower supply.

Regressior analysis will be used to specify and estimate officer supply models by major and specific programs. To test the validity of the supply models, they will be used to forecast accessions by area and program for a recent period.

The study also intends to assist in identifying new variables that more accurately profile local area officer supply conditions and therefore should be included in the NRC's goal allocation model.

II. LITERATURE REVIEW

A. A REVIEW OF OFFICER SUPPLY STUDIES

Enlisted personnel supply has been studied extensively since the advent of the all-volunteer force in 1973. Borack [Ref. 1:pp. 5-6] provides a good summary of past studies.[2] Studies about officer supply, on the other hand, are almost nonexistent, perhaps because of the greater cost of meeting enlisted accession requirements.

Snyder [Ref. 2] addresses the issue of officer recruiting over the time period from 1970 to 1982. He looks at the quality of applicants--in general and with respect to geographical differences. He also examines various officer recruiting sources to find the effects of changes in officer recruiting methods and scientific-technical education requirements on officer recruiting and accessions. Snyder concludes that the quality of officers increased during this period, and that accessions will be no problem in future years. However, he predicts that retention will be a problem. The underlying assumption is that officer recruiting is less sensitive than enlisted recruiting to economic and labor market conditions because "the need for financial assistance

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[2] In addition see: James N. Dertouzos, Enlistment Supply, Recruiter Objectives, and the All-Volunteer Army, 1984; Gary A. Nelson, "The Supply and Quality of First-Term Enlistees under the All-Volunteer Force", The All-Volunteer Force after a Decade, William Bowman et al., 1986.

during college . . . exists for most families even during economic good times" [Ref. 2:p. 413]. This is probably true, especially in more recent years as tuition for colleges and universities has increased rapidly. On the other hand, the declining youth population probably forces education institutions to temper any tuition increases and to be more aggressive in recruiting students, which then affects officer recruiting. [Ref. 3:p. 135]

Snyder assumes that recruiting of women and minority officers is no longer a problem and that geographic differences in recruiting will be balanced through selection procedures and large numbers of applicants. The determining factor in the selection for the military academies is the equal share of appointments allocated to each member of Congress. Reserve Officer Training Corps (ROTC) scholarships get selected in a national competition and the final selection for Officer Candidate School (OCS) is also done at the national level. These selection procedures can provide geographical representativeness for the specific programs. However, these three sources are not the only commissioning sources, and demographic changes still may have an effect upon the geographic representativeness of officers in the future.

Data on the share of national population per region versus the regional origination of officers in the Department of Defense (DoD) support Snyder's assumptions for the time period 1970-1982 for the Northeast and the North Central regions, but

not for the South and the West. The differences for the South, the West, and the Northeast are greater, comparing the percentage of officers by origin within DoD with the share of undergraduates by region. Table 1 shows the differences in representativeness per region based on an index given by:

$$I = \frac{O_R / O_D}{P / P_N} \tag{2.1}$$

Where:

O_R = Number of officers per regional origin
O_D = Total number of officers within the DoD
P = Population per region (P_R) or
Population of undergraduates per region (P_U)
P_N = Total national population

If the index equals one, the representativeness is perfect. An index above one shows that more officers are recruited from this region and vice versa.

Table 1 indicates that the North Central region is close to perfect representativeness, while the South supplies more officers and the West is heavily underrepresented with regard to the share of national and undergraduate population.

One explanation for these regional differences might be the geographic distribution of ROTC units, which does not always match the respective share of the undergraduate population. Table 2 provides the distribution of ROTC units based on the same computation as used for the officer representativeness.

TABLE 1

INDEX OF REGIONAL REPRESENTATIVENESS OF OFFICERS WITHIN DOD COMPARED TO TOTAL POPULATION AND COLLEGE UNDERGRADUATES

REGION	POPULATION	UNDERGRADUATES
Northeast	1.05	1.13
North Central	0.97	0.98
South	1.10	1.25
West	0.82	0.66

Source: Derived from Snyder [Ref. 2:pp. 415-418] using equation 2.1.

TABLE 2

INDEX OF REGIONAL DISTRIBUTION OF ROTC UNITS COMPARED TO TOTAL POPULATION AND COLLEGE UNDERGRADUATES

REGION	POPULATION	UNDERGRADUATES
Northeast	0.87	0.94
North Central	1.03	0.96
South	1.13	1.30
West	0.87	0.70

Source: Derived from Snyder [Ref. 2:pp. 415-418] using equation 2.1.

The Northeast has fewer ROTC units but provides relatively more officers, while the South with significantly more ROTC units provides officers slightly below these ratios.

Therefore, officer supply must be influenced by factors other than ROTC location, which Snyder does not explore. Looking at officer quality by accession source, he addresses political and military policies for recruiting officers, and demographic trends, but leaves out economic conditions, which may be of greater importance to officer recruiting and accessions than he assumes.

Bres et al. [Ref. 4], develop an "Accession Into Designator" (AIDS) goal programming model to determine "the number of [Naval] officers that each commissioning source should produce and how . . . [they] should be distributed among occupational specialties[3] " [Ref. 4:p. 1]. The AIDS model is part of "The Structured Accession Planning System for Officers" (STRAP-O) used by the Navy. [Ref. 5] The main objective of this program is to evaluate the feasibility of a desired number of officers, based on attrition, accessions, and available officer candidates. However, the model's "central focus is on personnel inventory and accessions necessary to achieve" [Ref. 5:p. 2] the desired number of officers. Thus, both models determine optimal accessions (by source) based on the demand, but do not evaluate whether the necessary accession supply is attainable.

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[3]Occupational specialties are identified by designator and grouped for planning purposes in communities such as surface warfare, aviation, etc.

Serfass [Ref. 6] develops a preliminary officer enlistment model. Based on previous studies about enlisted manpower supply, he develops a forecasting model to predict Nuclear Propulsion Officer accessions. [Ref. 6:p. 10] He uses quarterly historical data for five years to predict the number of contracts signed in the six Navy Recruiting Areas (NRAs) and for the Navy Recruiting Command (NRC). The explanatory variables included were of three types: (1) Navy/military policies, (2) economic conditions, and (3) demographic data. [Ref. 6:pp. 11,15]

B. A NUCLEAR PROPULSION OFFICER ENLISTMENT SUPPLY MODEL

Serfass forecasts the number of new contracts signed for each of the six NRA's and the NRC, based on a linear model, which is estimated using stepwise multiple regression and ordinary least squares techniques. He examines some variables using lagged and unlagged combinations. This is done to determine whether each explanatory variable affects the success of recruiters contemporaneously or with a lag.

Stepwise regression is a useful method for exploratory analysis when many independent variables are available and the analyst has no theoretical basis for selecting among them. However, the basic stepwise regression method does not guarantee the best model or the one with the highest R-squared, nor is there any guarantee that the developed model is an accurate representation of the supply choices made by potential officer candidates. [Ref. 7:p. 762]

Serfass includes six explanatory and three dummy variables in his basic supply model. The stepwise regression reduces the number of statistically significant variables included in the final models to a range from two to five. [Ref. 6:pp. 40, 44-47] Statistical programs like SPSS or SAS provide more sophisticated model selection methods, for example, maximum R-squared improvement [Ref. 7:p. 765], which might have given better results. However, since the goal in this thesis is to predict accessions, maximum R-squared is not a useful criterion for selecting independent variables. Instead, all variables should be included which are generated by a labor supply model. The stepwise regression is, therefore, not an appropriate method with regard to the small number of included variables.

Serfass examines the correlation between explanatory variables with the aid of correlation coefficients and scatter plots. He finds positive correlation between the number of recruiters and the number of new contracts for Nuclear Propulsion Officers and uses the correlation coefficient value of 0.7 or higher as a critical value for omitting variables. [Ref. 6:pp. 28-29] Although the prior literature provides no firm answer regarding a value above which multicollinearity is assumed to be severe, a correlation coefficient of 0.7 is believed to be too high. As a result, further multicollinearity possibly inherent in the models is not examined. The use of scatter plots to examine multicollinearity is also

questionable. Simple bivariate techniques do not hold constant the effect of other independent variables. Omitting a variable is the simplest method to deal with problems of multicollinearity, but it may result in specification bias and misleading values of the estimated parameters.

The models developed by Serfass account for seasonal effects using dummy variables for quarters but no variable for a time trend is included. As economic data usually are influenced by time trends, a variable taking this into account should have been included. Ash, Udis, and McNown use a time variable in their enlistment supply model as a proxy for systematic change in taste for military service. [Ref. 8:p. 146] For the sample period (1967-1979), the time trend is negative for males and whites but positive for non-whites, except for the Air Force, where it is uniformly negative. [Ref. 8:p. 153] These results are expected because the data cover the Vietnam war and post-war eras.

1. Explanatory Variables

a. Recruiters

During the past several years, the NRC has had problems filling its quotas because the Navy reduced its recruiting resources, while at the same time the other services increased their resources. Lerro et al. point out that it was the extraordinary effort of the recruiters which prevented the Navy from failing to meet its goals. [Ref. 9:p. VII] Obviously, as labor market conditions get more hostile

toward military recruiting, the number of recruiters becomes an increasingly important factor for meeting established goals.

Several studies about enlisted supply include the number of recruiters per recruiting area. This variable must be handled with care. Based on data from time series of cross sections, Cotterman [Ref. 10:p. 10] expects a positive influence on enlistment through additional recruiters and assumes no effect on enlistment by recruiters from other services. He argues that the recruiter variable varies over time but not in cross section, although he admits that "cross-Service effects are a real possibility" [Ref. 10:p. 10] for aggregate time series. Goldberg [Ref. 11:p. 11], also using pooled time series of cross sectional data, reports positive cross effects, when recruiters from other services are added to a model. For all high school graduates in his estimated Navy enlistment supply model, the elasticity of an Air Force recruiter is as high as the one for the Navy recruiter (0.44). [Ref. 11:p. 27] This reflects the competition between recruiters leading to increased problems filling the quotas. Increasing the number of recruiters may increase supply to a certain point; but, if the ratio of recruiters to targeted population gets smaller, the returns per recruiter diminish.

To eliminate this problem, Serfass assumes that Dedicated Nuclear Propulsion Officer Program Recruiters (DNRs) are the only ones recruiting for their community. [Ref. 6:p.

18] But this assumption does not eliminate the problem. The targeted group is small, because the goal stresses high quality applicants, in whom other Navy recruiters and other services are interested too. Only one recruiting area shows significant response to the number of DNRs. [Ref. 6:pp. 40, 44-47] This leads to two conclusions: first, the number of recruiters has no effect on the actual recruitment, which is not supported by other studies, nor is it believed to be true under the above-mentioned labor market conditions; second, stepwise regression erroneously eliminated the recruiter variable, because recruiters fulfilled the goals even under extreme circumstances.

b. Goals

The above studies do not account for changes in the recruiter efforts with respect to given goals. Dertouzos [Ref. 12] shows that productivity of Army recruiters for enlisted personnel is affected by goals. Once the goals are achieved, there might be no further incentive to produce more recruits. [Ref. 12:pp. 6-9] Besides factors like recruiter awards for overachievement, recruiter goals must be based on predicted supply to assure that recruiters do not have to fear increasing goals based on their past performance.

The NRC establishes the annual goals per commissioning source, based on projected attrition and resulting manpower requirements. These goals therefore are based on demand. Changes in demand result in changes in actual supply,

unless the supply curve is inelastic, which can be assumed not to be true for officer supply. The aim of forecasting models is to predict whether and how this demand can be filled.

A problem arises if goals and recruiters are thought to be simultaneously determined. They are highly correlated in cross-sectional analysis, as shown by Borack and Siegel as well as by Jehn and Shugart.[4] Serfass finds that goals are statistically significant only for the entire NRC and the number of recruiters for only one of the six areas. [Ref. 6:pp. 44,47] If these results are correct, the question about goal and recruiter allocation for recruiting areas and districts would be of no further interest. Alternatively, it may be that a different estimating technique should be used to disentangle the effects of goals, recruiters, and enlistments.

c. **Advertising**

Besides other factors, advertising might be a major factor increasing the propensity to serve. Although the Army's budget for advertising exceeds the other services' budgets by many times, this does not always guarantee positive effects on propensity, as shown by the Youth Attitude Tracking Study. [Ref. 13] After years of decreasing propensity to

[4]Both studies are quoted from Goldberg [Ref. 6:p. 11]. Borack, J., and Siegel, B.S., An Econometric Model of Armed Forces Enlistment Levels, 1976; Jehn, C., and Shugart, W.F., Recruiters Quotas, and the Number of Enlistment, 1976.

join the armed forces the general tendency has been increasing for the past six years. For 1987, the propensity data for young males show that the Air Force and Army are above the Navy and Marine Corps. While the percentage increase for the Air Force and Navy were 2.2 and 1.2, respectively, there was virtually no change in either the Marine Corps (0.2 percent difference) or Army (-0.3 percent difference). Data for young females show the same ranking, but the propensities are closer together. [Ref. 13:pp. 46-51]

Serfass' argument for including "advertising costs" is the "attempt to determine the significance of the cost of recruitment of officers" [Ref. 6:p. 20]. This argument is wrong because: (1) advertising expenses are only a part of the costs of recruitment, and he did not examine whether they are the major influencing part; and (2) determining supply, it is a question of how much more can be recruited by increasing the advertising expenses. The cost of recruitment, for example, increases with pay raises too, but assuming "normal"--not above market wage increases--pay raises, this does not necessarily increase supply.

The assumption that increased advertising expenses increase supply was reasonable, but received support in only one of six areas. [Ref. 6:pp. 40, 44-47] This result is contrary to a recent study by Dertouzos et al. [Ref. 14], which indicates that advertising has an immediate effect on Army enlisted recruiting. The study by Dertouzos et al. also

points out that advertising might not only draw enlistees from the civilian sector, but also negatively influences the recruiting efforts of the other services. Although the results reflect enlistment behavior, concluding that advertising expenditures influence officer recruiting nationwide--perhaps less than enlistment recruiting--seems more reasonable than Serfass' assumption.

d. ***Economic Factors***

Models estimating enlisted personnel supply generally include economic factors such as unemployment and relative pay. [Ref. 11:pp. 7-8] Does this hold true for officer supply or is officer recruiting less sensitive to economic conditions? [Ref. 2:p. 413] Although Snyder's assumption about the need for financial help for college education might be true for most families, the question arises how firms which normally do not pay for general training/education change their attitude in spite of the decreasing youth population, and how their offered pay for college graduates often exceeds military pay. Individuals may be more interested in obtaining money for education from their civilian employer than to sign up for the military. [Ref. 9:p. VI]

In periods of low unemployment, potential applicants for the military can choose from a variety of work alternatives. As industry competes--via higher pay--for the same pool of personnel, military recruiters will find it more

difficult to fill goals. Therefore, to predict future supply, pay must be considered as an explanatory variable. It is usually measured as the military/civilian pay ratio. However, correlation between unemployment and pay ratio, must be examined. As the unemployment rate falls, the absolute difference between military and civilian pay may go up. Most of Serfass' significant equations included unemployment, but the pay ratio is never statistically significant. [Ref. 6:pp. 40, 44-47] The reason for these results might be the measurement of the unemployment rate as a percentage of the total labor force. Goldberg reports that he could not get reliable measures of the youth unemployment rate for Navy Recruiting Districts, which ould be a much more accurate measure. [Ref. 11:p. 21]

Pay elasticities in other cross-sectional studies on Navy enlistment supply range from -0.86 to 1.26, including one study that found no effect at all. Unemployment elasticities for the same studies are much smaller, ranging from 0.02 to 0.3. [Ref. 11:p. 8] Ash et al. report positive pay elasticities but find insignificant unrmployment elasticities for the Navy. [Ref. 8:p. 153] It is one of the only studies tc find insignificant unemployment effects on enlisted supply.

Dale and Gilroy commented on the study by Ash et al. Dale and Gilroy maintain that the Ash et al. study "failed to find an unemployment effect on enlistments because they did

not have available the most appropriate data for estimating their equations." [Ref. 15:p. 547] Other major points of criticism are the use of semiannual data on accessions, estimated for both draft and post-draft eras, and the definition of the dependent variable as total male accessions rather than contracts signed by high school graduates. [Ref. 15:p. 547] Some seasonal fluctuation is smoothed out by using semiannual data, but Dale and Gilroy show that their quarterly data on new contracts and a respective dummy variable allow for better accounting of seasonality.

The argument against accession data in enlisted supply models is that they are determined by demand--and can be regulated through the Delayed Entry Program--while new contracts are determined by supply. Therefore, to estimate an enlisted supply model, new contracts should be used as a dependent variable. Dale and Gilroy support their argument by showing the correlation of new contracts and unemployment rates. [Ref. 15:pp. 548-549]

The question still remains whether unemployment and relative pay are significant for officer accessions. As mentioned before, if the variety of work alternatives is high and the recruiting market turbulent, unemployment will tend to have some effect on officer recruiting.

e. *Demographic Factors*

Demographic changes have great influence on supply. Of primary interest for military personnel supply is

the youth population between the ages of 18 and 24 years. The size of this group decreases through 1996, followed by a moderate increase until 2010. This increase is partly a result of immigration and the rapid growth of minorities. [Ref. 16:pp. 6-8] The Hispanic 18-to-24-year-old age group is expected to increase between 11 and 12 percent per decade starting in 1990. This increase corresponds to 51 percent for the time period from 1990 to 2010, compared to a 3.9 percent increase for the total age group population. [Ref. 17:pp. 14-15]

Scholastic Aptitude Test (SAT) Median Scores show lower scores for minorities than for white students (except Asians/Pacific Americans) in all study fields. Differences are extreme in engineering, computer science, health and medical studies. [Ref. 18:p. 108] Recruiting in these fields has been difficult over the past several years. Although the market share of minorities has increased tremendously, and will continue to do so, problems may arise for recruiting from this reservoir. Assuming no essential change in SAT mean scores for minorities, goals for minority accessions might still be unattainable. As this aspect is important for long-range officer recruiting strategies, it must be used when projecting potential officer supply. Therefore, explanatory variables for the different groups of minorities have to be included in a labor supply model.

Serfass looks at a very specific market and includes demographic aspects only by calculating a market share for nuclear officers as "proportion of the national technical degrees . . . granted within each recruiting area . . . to the national total" [Ref. 6:p. 24]. Including at least a variable for racial composition of the population would have been useful.

Serfass' market share variable is statistically significant only for NRA 3, and he cannot reject autocorrelation between market share and the three seasonality variables significant for this Area. [Ref. 6:pp. 40, 44-47] People do not adjust instantaneously to changes in the economy or government policies. Therefore, it might have been better to lag the market share variable. Serfass' argument is that historical data for NRA 3 show a constant share of contracts, regardless of changes in the economy or government policies. [Ref. 6:p. 45]

It is also questionable whether the targeted market is correctly specified. Looking at white collar workers and college students in technical majors includes women who account for only a small percentage of Nuclear Propulsion Officers. This, and the fact that the number of women in the labor force is increasing, may have caused a specification bias leading to biased and misleading results in Serfass' thesis.

2. Dependent Variable

Serfass uses contracts signed per area as the dependent variable. Following the argument presented by Dale and Gilroy [Ref. 15:p. 547] regarding enlisted supply, this would be the correct dependent variable. However, Serfass' goal is to **predict** officer supply more than to **explain** it. Therefore, it might have been useful to investigate applications, contracts signed, and accessions to see which model explains officer recruitment and accessions best. This thesis will proceed along these lines and explore alternative measures of "supply."

Applications express the **total** available supply, although not everyone who turns in an application shows further interest later on or can actually enlist because he/she may not meet the qualifications. However, in the Navy it should be noted that applications have already been screened. Contracts signed show the supply at a certain point in time, but some might not enter the armed forces right away, while others may lose interest over time. Finally, accessions represent those who definitely join the Navy.

3. Results

The numbers of contracts for 1986, projected by Serfass seldom equal the actual numbers. The percentage errors per NRA range from 0 percent to 240 percent, and for the entire recruiting command from 7 percent to 21 percent. [Ref. 6:p. 51] NRC recruitment goals were achieved prior to the end

of fiscal year 1986. Serfass does not expect this to happen. If he had included a variable for time trend, he might have gotten some indications about likely changes in future accessions.

One assumption to explain the poor results achieved by Serfass is that there might have been unexpected actions like changes in bonuses, which affected the recruiting process, but were omitted from the model. [Ref. 6:p. 50] If this had happened, he should have been aware of it.

The chosen model, sample size, and quality of the historical data are also potential sources of prediction errors as well as changes in policies and goals. Serfass does not find changes in policies and goals, and he argues that improvement in recruiter productivity may have caused poor forecasting results. [Ref. 6:pp. 52-53] The conclusion about improved recruiter productivity is concurrent with findings by Lerro et al. regarding recruiter efforts. [Ref. 9:p. VII] Also, Serfass' data for predicted and actual contracts signed in 1986 show a peak in the third quarter and a sharp drop afterwards.[5] These results indicate that there may be little incentive for recruiters to exceed the established goals, as Dertouzos points out. [Ref. 12:pp. 6-9]

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[5]Serfass' study provides fourth quarter data for 1986 only for the first half of the quarter. However, the drop in contracts signed is significant.

Serfass' study is based on quarterly data for five years and six recruiting Areas. The pooled cross-section analysis, therefore, is based on a total sample size of 120 observations. However, for each individual Area, only 20 observations are available, which reduces his degrees of freedom.

Serfass assumes a linear relationship between the dependent variable and the explanatory variables. The literature about enlisted supply models indicates that very few studies use linear models. Most studies use Log-linear and Logit model specifications. The rationale behind a logarithmic transformation involves diminishing returns to recruiters. Diminishing returns to factor input means that beyond a certain level of production, each additional unit of factor input--holding all other factor inputs constant--will lead to smaller and smaller increments in production. For diminishing returns to scale, all factor inputs can change simultaneously. Again, after a certain level of production, the output becomes smaller and smaller compared to the units of input. In officer and enlisted supply models additional recruiters are expected to have diminishing returns.

Another useful feature of logarithmic models is that the slope coefficients measure the responsiveness or elasticity of the dependent variable with respect to each independent variable. The elasticity provides the percentage change

in the dependent variable for a one percent change in any independent variable.

To summarize, major criticisms about Serfass' methodology and the model specification are: (1) the use of stepwise regression to eliminate "not significantly influencing" variables; (2) the omitting of correlated variables; (3) the assumption about linearity; and (4) the definitions of some variables chosen to predict future supply.

III. DATA SOURCES, MODEL, AND SAMPLE

The purpose of this thesis is to determine whether a supply model can be developed which would be useful in predicting future officer accessions. Data that are used to develop the supply model and data sources are described first. Then, a basic officer supply model is derived from a theoretical model about officer accessions, followed by an investigation of variables which should be included to improve predictions of accessions.

A. DATA SOURCES

The Navy Recruiting Command provided historical data files for fiscal years 1986 through 1988 on 30,802 individual officer applications (fleet input excluded). The number of new contracts and accessions over the same time period total 16,736 and 14,200, respectively. The data are aggregated for each of the 41 recruiting Districts and each fiscal year for applications, new contracts, and accessions. This provides a pooled, time series cross-sectional data base to analyze each of the three dependent variables--applications, contracts, and accessions.

The data on state unemployment rates for the respective years are obtained from the "Statistical Abstract of the United States" for 1986, 1987 [Ref. 19], and 1988 [Ref. 17]. Wage data--at the county level--are taken from files created by the Bureau of Labor Statistics. These data are grouped

into medical and non-medical wages to allow for separate models for medical and non-medical officer programs. Although the medical wages probably reflect the true average earnings for this group, the non-medical wage data are unlikely to accurately reflect the opportunity wage for other officer programs. It is likely that they overstate the civilian wages for non-engineering jobs and understate the civilian wages for engineering jobs.

The data on earned college degrees were obtained from files created by the National Center for Educational Statistics, which gathers these data every two years. The files contain individual data per college. The aggregation of these data to state level contains many missing values, which reduces the sample size and the degrees of freedom for regression analysis. Thus, aggregation to the county level was not possible.

The military-available population data at the county level were extracted from files prepared by Woods & Poole Economics, Inc. The data in these files are grouped into two categories: ages 17-21 and ages 22-29. Both groupings do not correspond with the target youth population, 18-24, which this thesis seeks to examine. However, it is assumed that the behavior of the 22-29 age group is similar to the target 18-24 group, so these data are therefore included. The data are extracted for the total military-available population and calculated separately for black, Hispanic, and white populations.

Because the six NRAs do not correspond with state boundaries, a cross-reference file is used to merge all data. This file allocates county- and state-level data to the respective NRDs. Table 3 provides sample size, means, and standard deviations of the variables created for the analysis.

TABLE 3

DESCRIPTIVE STATISTICS FOR OFFICER RECRUITING DATA[a]

VARIABLES	N	MEAN	STDEV
Applications	123	250.42	91.1
Contracts	123	136.80	55.8
Accessions	123	115.45	47.5
Unemployment Rate	123	6.62	1.9
Wage (annual $)	123	31,750	5,112
Recruiters	123	3.98	.2
Goals	123	450.84	151.5
Pop (22-29)	123	722,987	367,411
Black Pop (22-29)	123	79,554	60,778
Hispanic Pop (22-29)	123	47,674	87,711
White Pop (22-29)	123	595,759	275,149
Degrees	114	111,279	89,886

a. Data represent a pooled cross section of 41 NRDs over three years (1986-88)

B. A THEORETICAL MODEL OF OFFICER ACCESSIONS

The hypotheses concerning the impact of pay on officer accessions can be derived by applying a choice model, following Goldberg [Ref. 11] for enlisted recruitment and, Altman, and Barro [Ref. 20] for officer supply. To make a choice between two occupations, a person is assumed to compare the monetary earnings and nonmonetary benefits from both alternatives.

Altman and Barro view the nonmonetary benefits as a product of two components. One component has the same value for each person, while the other might be positive or negative, depending on the individual's valuation of the benefits. Altman and Barro assume that a potential applicant decides to become an officer if the total of military monetary and nonmonetary returns is greater than the sum of the respective returns from a civilian occupation. The authors further assume a proportional relationship between monetary earnings and nonmonetary benefits for each person and occupation and define the "relative civilian/military taste factor" leading to the "relative pay differential" for military/civilian earnings. [Ref. 20:p. 650] A relative pay differential shows what is necessary to make someone indifferent between two alternative occupations.

The choice model for a potential officer candidate can be written as follows[6]:

$$E_M + B_M > E_C + B_C \qquad (3.1)$$

Where:

E_M = military earnings
B_M = nonmonetary military benefits (in money terms) (can be positive or negative)
E_C = civilian earnings
B_C = nonmonetary civilian benefits (in money terms) (can be positive or negative)

If the military earnings E_M exceed $E_C + B_C - B_M$, which is called the reservation wage or supply price[7], the candidate decides to join the military:

$$E_M > E_C + B_C - B_M \qquad (3.2)$$

The difference of $B_C - B_M$ represents the net taste for the military. The pay differential E_M / E_C then follows from equations 3.1 and 3.2 as:

$$E_M / E_C > 1 + (B_C - B_M) / E_C \qquad (3.3)$$

This model assumes, then, that the decision to join the military is influenced by expected civilian earnings and the nonmonetary benefits in the civilian and military occupation.

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[6] The model follows Goldberg's choice model. [Ref. 11:p.18]

[7] See Cooper, R., Military Manpower and the All-Volunteer Force, Santa Monica, 1977, for a discussion about the use of supply price versus reservation wage.

Another argument for including pay and/or wages in a supply model is that fast-changing technology affects military and private industry in the same way. Both sectors have an increasing need for technically-skilled people and compete for them. The major advantage for private industry is its capability to pay much higher earnings than the military But firms normally do not provide general training and most technical training is general in nature. The Services, on the other hand, provide applicants with general training in return for an obligation to serve. The choice model implies that the majority of applicants for officer programs compares the returns from education and obligated time with possible earnings in the civilian (local) market; the greater the differences, the less likely a person will be to join the military.

The variable for wages that is included in the supply model is separated into medical and non-medical wages. Wage levels rather than a pay-ratio are used, because this thesis focuses on college graduates and qualified medical personnel such as doctors and nurses. The majority of these new officers join the Navy with the same rank, although there are differences between occupations such as the surface warfare and medical communities. The assumption is that under these circumstances the civilian wage level provides the same information as the military-civilian pay ratio. Increases in

civilian wages are expected to have a negative impact on officer applications, new contracts, and accessions.

1. Unemployment

Unemployment rates are commonly used as predictors of change in enlisted manpower supply. As mentioned before, it is difficult to obtain data on youth unemployment rates for specified recruiting areas. [Ref. 11:p. 21] Consequently, state unemployment rates for all age groups are used instead. This variable introduces some measurement errors. Young people may be more likely to get a job, even with high unemployment rates, than older people. However, if no data on youth unemployment are available, the state unemployment rates must be used as an approximation. Higher unemployment should lead to increased supply for the military, although the effect might be overstated.

2. Taste for the Military

Recent announcements about troop reductions, budget cuts, and the dramatic changes in the political environment in the Soviet Union and Europe will affect the demand for and the supply of manpower to the military.

Declining demand increases competition between those intending to join the armed forces. By the same token, chances for applicants with lower Scholastic Aptitude Test (SAT) scores decline. As mentioned above, minorities tend to score lower than white counterparts. [Ref. 18:p. 108] For fiscal year 1987, shortfalls for black officer candidates in the

Officer Candidate School and Aviation Officer Candidate School Program were more than 42 percent. This situation, in light of equal opportunity, is problematic for the Navy; and, based on 1987 data, it is assumed that the Navy needs at least up to the end of the year 2000 to level out these differences. [Ref. 18:pp. 113-114]

Troop reductions and a reduced threat from the Warsaw Pact, on the other hand, may result in the following "worst" and "best" case scenarios:

1. The intention to serve in the military decreases, reducing the supply for officers. But, depending on the magnitude of the decrease, this might have a severe impact on recruiting--if the decrease is large--or might be just equal to the decreased demand.

2. Potential officer candidates "rush" to sign up for the military, creating a large surplus of potential officer candidates and a large buffer in the Delayed Entry Program (DEP). The buffer can be used in future years to fulfil the accession goals. A disadvantage is that candidates might lose interest in the military if their entrance is delayed over a longer period.

The recruiting situation for minorities may not get worse, but it definitely will not get better under these circumstances. As the magnitude of the above changes cannot be determined precisely at this moment, an additional problem arises in measuring the propensity to serve for officer

candidates. There is no study available which measures this factor. The Youth Attitude Tracking Study (YATS), used for enlisted supply models, provides a measurement of propensity, but it does not include college attendees. [Ref. 13:p. 2] It might be possible to derive a proxy by projecting YATS data from high school seniors; but the time between being surveyed and eligible to join the military is too long to expect reasonable results. Those who have positive attitudes toward the military might change their attitude over time. Including an approximation in the supply model would probably cause prediction errors. Instead, dummy variables for the six Navy Recruiting Areas (NRAs) and a time trend are included to account for unmeasured regional differences in tastes, and changes over time in tastes for the military.

3. Demographic Factors

In addition to the decreasing proportion of youth combined with the growing proportion of minorities, the composition of the labor force will change even more due to the fact that 65 percent of all new job applicants in 1990 will be women. [Ref. 16:p. 9][§] However, this does not mean that women will also make up 65 percent of technical majors in college. In fact, women tend to select non-technical majors, a pattern also found for minorities. [Ref. 18:p. 110]

[§]The percentage number is quoted in Ref. 16 from Government statistics cited in Anthony M. Casale, Tracking Tomorrow's Trend (Kansas City: Andrews, McMeel, and Parker 1980), p. 57.

Modern military systems have an increasing need for officers trained in technical areas. As mentioned (in Chapter I,B1), minorities tend to have lower SAT scores than white students, especially in technical studies. In spite of the declining supply of white males, selection standards currently emphasizing mathematical abilities disregard potential resources and hamper equal opportunities for minorities. Variables for racial and ethnic origin are included in the supply model and are assumed to have a negative impact on officer supply.

Most studies on enlisted supply are restricted to young men, but the Navy has experienced problems in recruiting women too. Recruiting nurses, for example, has been difficult during recent years. Accession data for Army nurses for fiscal year 1987 show that 53.8 percent were under 25 years when they joined the military. [Ref. 21:p. 11] This is the age group this thesis is examining. Thus, the basic officer supply model includes both men and women in the population variables.

To determine the goal share for each recruiting area, the Navy includes the share of college degrees in the "Generic Officer Goaling Model." Therefore, a variable for earned college degrees is added to the basic officer supply model. Increased competition with private industry--especially due to higher earnings for jobs in the industry--will probably make recruiting from this pool more difficult. Despite this,

the effect of the variable on officer supply is expected to be positive.

4. Recruiters and Goals

The number of recruiters has significant explanatory power in prior studies on enlisted recruitment, and it is expected that it will also have a positive impact on officer recruitment. The effect of recruiters efforts, however, is subject to diminishing returns (as explained in Chapter II.3).

The variable for recruiters can be added to the supply model with respect to each NRA or as the total number of recruiters appointed by the NRC. Applying the number of recruiters in each NRA might cause an upward-biased effect if the Navy distributes disproportionately more recruiters to fertile recruiting areas. [Ref. 10:p. 10] Assuming that the Navy does not change its recruiter allocation from year to year, it might therefore be a better approach to apply the number of recruiters per NRA than the total number on the national level.

Established goals per recruiter are based on projected attrition and resulting manpower requirements. These goals--distributed over all recruiters--direct recruiter efforts toward specific targeted groups. Thus, recruiter efforts are determined by goals [Ref. 12], and goals can be used to measure recruiter productivity. Therefore, a supply model must include goals as an explanatory variable, although they might be highly correlated with the number of recruiters per

recruiting area. Higher goals are expected to lead to increased recruitment, although with a diminishing effect.

5. Accessions, New Contracts, and Applications

The dependent variable in supply models is usually defined as the number of accessions or the number of new contracts. Both variables express supply for the Navy, but reflect different situations. Accessions--those who join the Navy at a certain point in time--are determined through available capacities in the Naval Academy or the Officer Candidate School, while new contracts are the result of established recruiting goals. This thesis will use both variables to see which dependent variable is explained better by the model. Accessions and new contracts do not reflect the true supply available for the Navy. The number of applicants[9], on the other hand, can be used as an approximation for the entire available supply. A supply model should also be estimated with respect to applications, and it is expected that this model would differ from the above two.

6. An Econometric Model of Officer Supply

Regression analysis on a log-linear function is used to estimate the effects of economic factors, demographic factors, and recruiting resources on officer supply. The log-linear functional form accounts for diminishing returns to

[9]Applications are only an approximation of total supply because the Navy screens applicants before an application is sent to the NRC.

each variable and the estimated coefficients represent the respective elasticities.

The basic officer supply model is given by:

SUPPLY = f (UNEMPL, WAGE, RECRS, GOAL,
POP29, DEGREE, RACE, ETHNIC,
NRA3, NRA4, NRA5, NRA7, NRA8,
YEAR87, YEAR88) (3.4)

Alternatively, supply is estimated with three different variables: APPLICATIONS, CONTRACTS, and ACCESSIONS as the dependent variable. Base cases for the models are the recruiting Area One (NRA1) and fiscal year 1986.

Table 4 provides a definition of the variables used in the different models.

TABLE 4

DEFINITION OF VARIABLES

VARIABLE NAME	DEFINITION
ACCESS	Accessions per NRD and year
CONTRACT	Contracts per NRD and year
APPLICAT	Applications per NRD and year
UNEMPL	Unemployment rates for civilian non-institutional population
WAGE	Market wages for medical and non-medical employees
RECRS	Recruiters per NRD

TABLE 4 (Continued)

GOAL	Goals per NRD
DEGREE	Earned degrees
POP29	Military-available population, ages 22-29
WH29	White population ages 22-29
HSP29	Hispanic population ages 22-29
BLK29	Black population ages 22-29
NRA3	Dummy variable equal to one for NRA3
NRA4	Dummy variable equal to one for NRA4
NRA5	Dummy variable equal to one for NRA5
NRA7	Dummy variable equal to one for NRA7
NRA8	Dummy variable equal to one for NRA8
YEAR87	Dummy variable equal to one for FY 87
YEAR88	Dummy variable equal to one for FY 88

7. Analysis

Regression models are first estimated for the total number of applications, contracts, and accessions. Each dependent variable is examined, including and excluding the variable for college degrees. Each model is then regressed with three different model specifications. In the first specification, the dependent variables and the variables for recruiters, goals, and degrees are divided by the total military-available population. This provides a supply model where the supply variable is adjusted for population. In the second specification, the military-available population is

included as an explanatory variable. In the third specification, the military available population for blacks, Hispanics, and whites are included as explanatory variables. The coefficient estimates are presented in Tables 5 through 10.

Tables 5, 6, and 7 present the ordinary least squares regression equations, excluding the degrees variable. Only model 1 in Table 5 and models 1 and 2 in Table 7 have the correct signs. The estimated effects of the recruiters and goal variables are not statistically significant for any model.

TABLE 5

COEFFICIENT ESTIMATES OF ALTERNATIVE SUPPLY MODELS USING APPLICATIONS[a]

VARIABLE	MODEL 1. APPLICAT	MODEL 2. APPLICAT	MODEL 3. APPRATE[b]
CONSTANT	-1083.117 (-1.242)	-1000.947 (-.831)	.349 (2.659)
UNEMPL	3.137 (.118)	-4.746 (-.167)	-.00022 (-.056)
WAGE	-180.363 (-3.373)	-158.202 (-3.039)	-.025 (-3.141)
RECRS	5.537 (.068)	1.801 (.021)	.003 (.287)
GOAL	108.437 (.945)	110.601 (.914)	.007 (.590)
POP29	187.675 (10.174)	N/I	N/I

TABLE 5 (Continued)

BLK29	N/I	19.497 (2.417)	N/I
HSP29	N/I	4.632 (.581)	N/I
WH29	N/I	147.847 (5.407)	N/I
NRA3	35.640 (.637)	36.604 (.581)	.003 (.990)
NRA4	2.952 (.067)	8.454 (.181)	-.002 (-.458)
NRA5	-44.908 (-1.293)	-38.288 (-1.013)	-0.008 (-2.005)
NRA7	-51.397 (-.763)	-35.422 (-.463)	-0.011 (-2.409)
NRA8	-51.658 (-.975)	-8.794 (-.217)	-.007 (-1.572)
YEAR87	39.600 (.772)	38.911 (.720)	.001 (.248)
YEAR88	14.650 (.187)	13.005 (.158)	-.005 (-.561)
NUMBER OF OBS.	123	123	123
R^2 - ADJUSTED	.67	.68	.54
F-STATISTIC	21.732	19.468	14.032

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, and GOAL are divided by the military-available population.
N/I = not included.

TABLE 6

COEFFICIENT ESTIMATES OF ALTERNATIVE SUPPLY MODELS USING CONTRACTS[a]

VARIABLE	MODEL 1. CONTRACT	MODEL 2. CONTRACT	MODEL 3. CONRATE[b]
CONSTANT	-667.445 (-1.253)	-622.884 (-.849)	.153 (2.770)
UNEMPL	1.016 (.063)	-1.465 (-.084)	-.00008 (-.035)
WAGE	-110.772 (-3.392)	-96.891 (-2.094)	-.014 (-2.991)
RECRS	-14.466 (-.290)	-15.856 (.302)	.002 (.272)
GOAL	95.545 (1.364)	96.868 (1.314)	.003 (.464)
POP29	106.471 (9.451)	N/I	N/I
BLK29	N/I	8.600 (1.749)	N/I
HSP29	N/I	4.316 (.888)	N/I
WH29	N/I	83.249 (4.995)	N/I
NRA3	27.831 (.814)	31.324 (.815)	.002 (1.028)
NRA4	2.055 (.077)	5.899 (.209)	-.002 (-.784)
NRA5	-31.737 (-.480)	-27.086 (-1.176)	-0.006 (-2.626)
NRA7	-19.850 (-.821)	-12.351 (-.265)	-0.007 (-2.432)
NRA8	-18.850 (-.821)	-6.624 (-.269)	-.004 (-1.617)

TABLE 6 (Continued)

YEAR87	11.894 (.380)	11.743 (.357)	.003 (-1.036)
YEAR88	11.424 (.239)	10.970 (.218)	-.006 (-1.232)
NUMBER OF OBS.	123	123	123
R^2 - ADJUSTED	.67	.64	.57
F-STATISTIC	21.873	16.350	15.912

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, and GOAL are divided by the military-available population.
N/I = not included.

TABLE 7
COEFFICIENT ESTIMATES OF ALTERNATIVE SUPPLY MODELS USING ACCESSIONS[a]

VARIABLE	MODEL 1. ACCESS	MODEL 2. ACCESS	MODEL 3. ACCRATE[b]
CONSTANT	-392.937 (-.844)	-226.403 (-.354)	.155 (3.170)
UNEMPL	6.230 (.440)	3.938 (.260)	-.0009 (-.440)
WAGE	-105.116 (-3.684)	-102.057 (-2.476)	-.014 (-3.305)
RECRS	6.413 (.147)	4.933 (.108)	.005 (.784)
GOAL	61.682 (1.007)	62.093 (.966)	-.0004 (-.071)
POP29	89.016 (9.042)	N/I	N/I
BLK29	N/I	7.668 (1.789)	N/I

TABLE 7 (Continued)

HSP29	N/I	5.050 (1.192)	N/I
WH29	N/I	65.677 (4.521)	N/I
NRA3	25.667 (.859)	25.564 (.763)	.002 (1.232)
NRA4	-1.404 (-.060)	1.566 (.064)	-.002 (-1.016)
NRA5	-27.835 (-1.501)	-25.947 (-1.292)	-0.005 (-2.663)
NRA7	-17.553 (-.488)	-16.406 (-.404)	-0.006 (-2.378)
NRA8	-12.029 (-.599)	-3.294 (-.153)	-.003 (-1.352)
YEAR87	2.681 (.098)	2.362 (.082)	-.004 (-1.478)
YEAR88	-5.212 (-.125)	-5.877 (-.134)	-.008 (-1.744)
NUMBER OF OBS.	123	123	123
R^2 - ADJUSTED	.66	.62	.57
F-STATISTIC	20.312	15.254	15.982

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, and GOAL are divided by the military-available population.
N/I = not included.

Adding college degrees to the models, the coefficient estimates for goals and recruiters should decrease because the three variables are related to each other. Tables 8, 9, nd 10 show that the effect of adding college degrees to the models is twofold. First, model 3 in column 3, which is based on ratios, shows essentially no change in the coefficient

estimates or in the significance levels for unemployment, wage, recruiters, and goals. Second, for models 1 and 2 in columns 1 and 2, the impact of goals increases--which is exactly the opposite to what was expected--while the estimates for unemployment, wage, and population decrease. The interesting exceptions for population estimates are the coefficients for Hispanics, which increase.

Tables 8 through 10 show that the coefficient estimates for the unemployment rate are always insignificant. They are all positive only in the regressions on total accessions. This result leads to the conclusion that unemployment does not have much effect on officer supply. This was expected, because college graduates face fewer unemployed problems than those without a college degree. Therefore, state level data on unemployment do not fit the population under investigation.

TABLE 8

COEFFICIENT ESTIMATES OF ALTERNATIVE SUPPLY MODELS USING APPLICATIONS[a]

VARIABLE	MODEL 1. APPLICAT	MODEL 2. APPLICAT	MODEL 3. APPRATE[b]
CONSTANT	-1107.836 (-1.213)	-905.356 (-.714)	.364 (2.499)
UNEMPL	1.162 (.041)	-3.140 (-.101)	-.00054 (-.123)
WAGE	-156.541 (-2.648)	-138.873 (-1.668)	-.026 (-2.829)

TABLE 8 (Continued)

RECRS	2.313 (.027)	-.271 (-.003)	.003 (.256)
GOAL	112.954 (.945)	114.105 (.898)	.008 (.627)
DEGREE	-13.060 (-2.590)	-13.488 (-2.463)	-.00053 (-.679)
POP29	180.884 (9.476)	N/I	N/I
BLK29	N/I	17.771 (1.958)	N/I
HSP29	N/I	7.943 (.948)	N/I
WH29	N/I	134.535 (4.664)	N/I
NRA3	35.253 (.617)	34.986 (.537)	.003 (.908)
NRA4	1.685 (.038)	7.065 (.149)	-.002 (-.410)
NRA5	-39.078 (-1.101)	-34.502 (-.894)	-0.007 (-1.822)
NRA7	-41.244 (-.595)	-33.050 (-.418)	-0.011 (-2.156)
NRA8	-41.355 (-1.065)	-19.754 (-.465)	-.006 (-1.348)
YEAR87	43.263 (.805)	42.574 (.745)	.002 (.354)
YEAR88	18.896 (.232)	17.503 (.202)	-.004 (-.416)
NUMBER OF OBS.	114	114	114

TABLE 8 (Continued)

R^2 - ADJUSTED	.69	.65	.53
F-STATISTIC	20.284	14.945	11.689

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, GOAL, and DEGREE are divided by the military-available population.
N/I = not included.

TABLE 9

COEFFICIENT ESTIMATES OF ALTERNATIVE SUPPLY MODELS USING CONTRACTS[a]

VARIABLE	MODEL 1. CONTRACT	MODEL 2. CONTRACT	MODEL 3. CONRATE[b]
CONSTANT	-664.535 (-1.218)	-493.854 (-.654)	.149 (2.352)
UNEMPL	-2.446 (-.145)	-2.768 (-.149)	-.00019 (-.073)
WAGE	-96.142 (-2.723)	-87.819 (-1.773)	-.014 (-2.648)
RECRS	-19.182 (.380)	-19.926 (-.373)	.002 (.235)
GOAL	100.763 (1.412)	101.203 (1.339)	.004 (.571)
DEGREE	-9.342 (-3.193)	-10.056 (-3.085)	-.00051 (-1.123)
POP29	102.035 (8.954)	N/I	N/I
BLK29	N/I	7.415 (1.373)	N/I
HSP29	N/I	6.976 (1.398)	N/I
WH29	N/I	73.285 (4.269)	N/I

TABLE 9 (Continued)

NRA3	27.314	29.041	.002
	(.800)	(.749)	(1.034)
NRA4	2.096	5.655	-.002
	(.078)	(.200)	(-.677)
NRA5	-26.330	-23.912	-0.006
	(-1.243)	(-1.041)	(-2.355)
NRA7	-12.940	-11.598	-0.006
	(-.313)	(-.247)	(-2.127)
NRA8	-22.462	-14.937	-.004
	(-.969)	(-.591)	(-1.391)
YEAR87	14.105	13.883	-.003
	(.439)	(.408)	(-.820)
YEAR88	14.680	14.267	-.005
	(.302)	(.277)	(-1.018)
NUMBER OF OBS.	114	114	114
R^2 - ADJUSTED	.70	.67	.57
F-STATISTIC	21.589	16.090	13.652

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, GOAL, and DEGREE are divided by the military-available population.
N/I = not included.

TABLE 10

COEFFICIENT ESTIMATES OF ALTERNATIVE SUPPLY MODELS USING ACCESSIONS[a]

VARIABLE	MODEL 1. ACCESS	MODEL 2. ACCESS	MODEL 3. ACCRATE[b]
CONSTANT	-361.532	-105.496	.153
	(-.751)	(-.159)	(2.734)
UNEMPL	4.180	3.282	-.0008
	(.280)	(.201)	(.363)

TABLE 10 (Continued)

WAGE	-94.940 (-3.046)	-95.270 (-2.189)	-.014 (-2.956)
RECRS	1.917 (.043)	.850 (.018)	.005 (.718)
GOAL	64.389 (1.022)	64.229 (.967)	.0004 (.058)
DEGREE	-7.044 (-2.649)	-7.798 (-2.723)	-.0004 (-.916)
POP29	85.019 (8.449)	N/I	N/I
BLK29	N/I	6.747 (1.422)	N/I
HSP29	N/I	7.026 (1.603)	N/I
WH29	N/I	57.521 (3.814)	N/I
NRA3	23.670 (.785)	22.318 (.655)	.002 (1.185)
NRA4	-2.702 (-.115)	.236 (.010)	-.002 (-.947)
NRA5	-25.218 (-1.348)	-24.318 (-1.205)	-0.005 (-2.449)
NRA7	-14.908 (-.408)	-17.936 (-.434)	-0.006 (-2.155)
NRA8	-14.189 (-.693)	-9.360 (-.421)	-.003 (-1.080)
YEAR87	3.936 (.139)	3.568 (.119)	.004 (-1.235)
YEAR88	-3.258 (-.076)	-3.900 (-.086)	-.007 (-1.502)

TABLE 10 (Continued)

NUMBER OF OBS.	114	114	114
R^2 - ADJUSTED	.68	.64	.57
F-STATISTIC	19.468	14.663	13.706

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, GOAL, and DEGREE are divided by the military-available population.
N/I = not included.

Tables 8 through 10 show that estimates for wages are always negative and usually significant at the 5-percent significance level. The results support the assumption that civilian wage increases tend to reduce the supply of officers for the Navy.

Although insignificant for each model, the estimates for recruiters are positive for accessions (as shown in Table 10) and applications (as shown in Table 8), with the exception of model 2 (in column 2). However, Table 9 shows that the coefficient of recruiters in the contracts model tends to be negative. An explanation might be that recruiters affect applications more than contracts because they cannot determine which applicant will be selected. On the other hand, the positive estimates for accessions reflect the recruiter efforts devoted to those who signed a contract, to keep them interested and to eventually join the Navy.

The coefficients for the military-available population, entered either as a total or divided into race and ethnic groups, are always positive and, in most cases,

significant. This supports the assumption that the behavior of 22-29 year olds is comparable to those in the 18-24 age group.

To capture the unmeasured taste for the military, dummy variables for each NRA are included in each model. The base case is NRA1, the smallest recruiting Area. Tables 8 through 10 show that the coefficients for NRA3 are always positive. NRA4 has some positive coefficients, and the remaining NRAs have negative coefficients. This means that recruiting for the Navy should be easier in Areas 3 and 4 (compared to NRA1) and more difficult in Areas 5, 7, and 8. This result is reasonable. NRAs 3 and 4 are located along the east coast, where the majority of naval bases are also located. In addition, these Areas are densely populated.

The dummy variables for time trend show no unique behavior across accessions, applications, and contracts. The main trend for accession models is a turn from positive to negative from 1987 to 1988, while applications and contracts are primarily stable.

The estimated effect of the goal variable is positive, but always insignificant. Before these results are discussed, the estimates for college degrees are presented. This is done because goals and college degrees are related, and their influence on supply should be investigated together.

The estimates for earned degrees are positive and insignificant for those models where degrees are divided by

the available military population. They are negative but significant at the 5-percent significance level for all other models.

The assumption for recruiters, goals, and degrees is that they all would be positive and significant. To see, how the variables are related and influence each other, the simple correlation matrices are investigated; and, in a second step, the variables for recruiters and goals are omitted from those models that include degrees. Tables 11 and 12 present the correlation matrices for the regression models with and without ratios. Tables 13 through 15 include the regression equations, omitting recruiters and goals.

TABLE 11

CORRELATION COEFFICIENTS FOR MODELS USING ACCESSION RATIOS

VARIABLES	UNEMPL	WAGE	RECRS	GOAL	DEGREE
UNEMPL	1.0000				
WAGE	-.2259**	1.0000			
RECRS	-.1029	-.3055*	1.0000		
GOAL	.1033	-.2819*	.7787*	1.0000	
DEGREE	.0593	-.1234	.4410*	.3464*	1.0000

* Significant at the 5-percent significance level.
** Significant at the 10-percent significance level.

Both matrices show that goals are highly correlated with recruiters. Data in Table 11 verify that officer

recruiters tend to be placed in areas where college degrees are higher. The correlation of recruiters and goals with degrees, however, is negative (as shown in Table 12) and fairly low.

TABLE 12

CORRELATION COEFFICIENTS FOR MODELS USING ACCESSION LEVELS

VARIABLES	UNEMPL	WAGE	RECRS	GOAL	DEGREE
UNEMPL	1.0000				
WAGE	-.2259**	1.0000			
RECRS	-.3628*	.4649*	1.0000		
GOAL	.0613	.2105**	.5152*	1.0000	
DEGREE	.0379	.0568	-.0839	-.0608	1.0000

* Significant at the 5-percent significance level.
** Significant at the 10-percent significance level.

Because of the correlation between recruiters, goals, and degrees, if the first two variables are omitted, the coefficient estimates for degrees should increase and become positive. This assumption is supported by model 3 (column 3 in Tables 13-15), although degrees are still insignificant. Moreover, the variable for unemployment becomes negative for contracts and applications. Coefficient estimates for degrees in models 1 and 2 change only slightly and remain negative. Most dummy variables become positive for the reduced

regression models. One explanation for the negative coefficients for earned degrees is that while recruiters must recruit from the college population, higher college population do not necessarily translate into greater interest or enlistment in the Navy. That is, the "take" from any given college market is so small that the population does not appear to be closely associated with supply.

TABLE 13

COEFFICIENT ESTIMATES OF SUPPLY MODELS USING APPLICATIONS[a] (OMITTING RECRUITERS AND GOALS)

VARIABLE	MODEL 1. APPLICAT	MODEL 2. APPLICAT	MODEL 3. APPRATE[b]
CONSTANT	-306.625 (-.572)	-62.750 (-.066)	.500 (5.697)
UNEMPL	-.465 (-.017)	-5.081 (-.992)	.00035 (.077)
WAGE	-159.187 (-2.705)	-144.742 (-1.752)	-.043 (-5.250)
DEGREE	-12.987 (-1.506)	-13.453 (-2.469)	.00045 (.578)
POP29	181.096 (9.527)	N/I	N/I
BLK29	N/I	18.243 (2.025)	N/I
HSP29	N/I	8.352 (.999)	N/I
WH29	N/I	133.342 (4.653)	N/I

TABLE 13 (Continued)

NRA3	-21.878 (-1.064)	-22.722 (-.774)	-.001 (-.372)
NRA4	-38.099 (-1.506)	-32.326 (-1.202)	-.006 (-1.498)
NRA5	-66.937 (-2.586)	-62.577 (-2.342)	-0.012 (-3.091)
NRA7	-109.324 (-3.822)	-101.931 (-2.607)	-0.021 (-4.499)
NRA8	-72.066 (-2.757)	-50.379 (-1.721)	-.016 (-4.040)
YEAR87	-7.657 (-.616)	-8.744 (-.662)	-.001 (-.548)
YEAR88	-56.490 (-4.012)	-58.691 (-3.918)	-.008 (-3.473)
NUMBER OF OBS.	114	114	114
R^2 - ADJUSTED	.69	.65	.48
F-STATISTIC	24.059	17.334	11.404

a. T-statistic in parentheses.
b. Dependent variable and variable DEGREE are divided by the military-available population.
N/I = not included.

TABLE 14

COEFFICIENT ESTIMATES OF SUPPLY MODELS USING CONTRACTS[a] (OMITTING RECRUITERS AND GOALS)

VARIABLE	MODEL 1. CONTRACT	MODEL 2. CONTRACT	MODEL 3. CONRATE[b]
CONSTANT	-45.973 (-.143)	152.017 (.267)	.270 (5.379)
UNEMPL	-2.921 (-.174)	-3.456 (-.188)	.00029 (.109)

TABLE 14 (Continued)

WAGE	-98.207 (-2.783)	-91.837 (-1.860)	-.023 (-4.915)
DEGREE	-9.287 (-3.083)	-10.027 (-3.078)	.000009 (.021)
POP29	102.263 (8.971)	N/I	N/I
BLK29	N/I	7.693 (1.428)	N/I
HSP29	N/I	7.226 (1.451)	N/I
WH29	N/I	72.627 (4.240)	N/I
NRA3	-14.159 (-1.148)	-13.005 (-.741)	-.0002 (-.129)
NRA4	-27.159 (-1.148)	-23.929 (-1.489)	-.004 (-1.693)
NRA5	-47.393 (-3.238)	-45.188 (-2.829)	-0.008 (-3.568)
NRA7	-63.288 (-3.690)	-62.693 (-2.682)	-0.011 (-4.332)
NRA8	-44.842 (-2.860)	-37.409 (-2.138)	-.009 (-3.916)
YEAR87	-30.489 (-4.091)	-30.868 (-3.912)	-.004 (-3.709)
YEAR88	-52.801 (-6.253)	-53.520 (-5.978)	-.007 (-5.728)
NUMBER OF OBS.	114	114	114
R^2 - ADJUSTED	.70	.68	.53
F-STATISTIC	25.300	18.445	13.997

a. T-statistic in parentheses.
b. Dependent variable and variable DEGREE are divided by the military-available population.
N/I = not included.

TABLE 15

COEFFICIENT ESTIMATES OF
SUPPLY MODELS USING ACCESSIONS[a]
(OMITTING RECRUITERS AND GOALS)

VARIABLE	MODEL 1. ACCESS	MODEL 2. ACCESS	MODEL 3. ACCRATE[b]
CONSTANT	97.907 (.346)	373.969 (.749)	.247 (5.579)
UNEMPL	3.255 (.218)	2.137 (.133)	.001 (.478)
WAGE	-96.457 (-3.106)	-98.634 (-2.282)	-.021 (-5.177)
DEGREE	-7.002 (-2.642)	-7.778 (-2.727)	.00007 (.177)
POP29	85.138 (8.487)	N/I	N/I
BLK29	N/I	7.020 (1.489)	N/I
HSP29	N/I	7.245 (1.662)	N/I
WH29	N/I	56.829 (3.789)	N/I
NRA3	-9.165 (-.844)	-10.631 (-.692)	-.0003 (-.184)
NRA4	-25.544 (-1.913)	-22.209 (-1.578)	-.004 (-1.816)
NRA5	-41.205 (-3.200)	-40.306 (-2.882)	-0.007 (-3.519)
NRA7	-54.009 (-3.578)	-57.218 (-2.796)	-0.010 (-4.143)
NRA8	-31.837 (-2.308)	-26.837 (-1.752)	-.007 (-3.399)
YEAR87	-25.113 (-3.829)	-25.358 (-3.670)	-.004 (-3.534)

TABLE 15 (Continued)

YEAR88	-46.226 (-6.221)	-46.779 (-5.967)	-.007 (-5.703)
NUMBER OF OBS.	114	114	114
R^2 - ADJUSTED	.68	.65	.54
F-STATISTIC	23.017	16.958	14.217

a. T-statistic in parentheses.
b. Dependent variable and variable DEGREE are divided by the military-available population.
N/I = noy included.

To summarize, none of the three variables discussed above behaves as expected. The estimated coefficients of recruiter and goals are positive, but tend to be insignificant, and the coefficients of degrees are just the reverse. Omitting two explanatory variables that are highly correlated to degrees does not affect the coefficients for degrees for the majority of models, but it does change the coefficients of the other variables.

There is no unique supply model that fits the total number of applications, contracts, and accessions at the same time. Applications and accessions can be estimated with the same supply model. This model includes the military-available population as an explanatory variable. Accessions can also be estimated using the model in which the effect of population data is determined separately for racial and ethnic origin. The assumption that a model for applications would differ from the one for contracts and accessions is not supported by these results.

The basic supply models are then estimated separately for specific officer programs such as nuclear officers, nurses, medical officers, and the entire medical corps. The results are displayed in the Appendix.

Degrees are not only unequally distributed across the NRDs, but some NRDs have no observation for a given occupational specialty. Therefore, the number of observations and degrees of freedom for these regressions are reduced, and the explanatory power of models tends to be poorer. The results are worse than expected. None of the models has the correct signs. However, an interesting result shown in the Appendix, Tables 16-18, is that the coefficient estimates for degrees become positive for nuclear officer supply models.

Because of the results, it is impossible to forecast future officer supply for special officer programs on the basis of the supply models presented here.

IV. CONCLUSION AND RECOMMENDATIONS

The objective of this thesis was to identify labor market, economic, demographic, and geopolitical factors and trends, that are believed to be important for officer accessions. Based primarily on previous studies of enlisted manpower supply, various factors are identified and incorporated in a basic officer supply model.

The study specifies three different models of officer supply. Three alternative dependent variables are used as supply measures: applications, new contracts, and accessions. It was hypothesized that applications would be a true measure of supply, since contracts and accessions are demand-constrained. The hypothesis that the model for applications would differ from the other two models was rejected. However, the statistically significant variables have much stronger effects on officer supply in the application models.

New contracts show incorrect estimates (signs) when the variable for earned degrees is added to the model. Dale and Gilroy [Ref. 15] argue that contracts are the correct dependent variable to predict enlisted supply, because they are determined by the need for new candidates. This is not supported by the data used for this study of officers.

The labor market situation would be incorporated best if youth unemployment data on county level were available. Unfortunately, these data are not available--a problem that

has also plagued prior studies of enlisted supply. State unemployment data are used instead. The unemployment variable is never statistically significant in the models. This might be partially the result of the data used. It can, however, also be interpreted that the impact of unemployment on the decision to join the Navy is smaller for college graduates because, unlike high school graduates, they are less likely to be unemployed.

The competition between private industry and the military for the same high quality, but declining, youth population is reflected through offered civilian wages, the number of military recruiters, and the established officer recruiting goals. Civilian wages are expected to influence the decision to join the Navy negatively. The choice model (Eqn. 3.2) implies that nonmonetary military benefits must be (subjectively) highly valued to compensate for higher civilian wages and nonmonetary benefits. Wages are highly significant for all models presented in Tables 8 through 10, an indicator of increasing difficulties in recruiting. If military pay stays constant, which in nominal terms is equivalent to a decrease in relative pay, the military must offer substantial nonmonetary benefits to be attractive to college graduates. The decreasing defense budget will probably hamper any attempt by the military in this direction, thus making future recruiting more difficult.

Although the wage variable behaves as expected in the total supply models, follow-on research efforts should try to incorporate more detailed wage data. Different data on wages in health care, for example, are available through the Defense Manpower Data Center.

The results for recruiters and goals are of major interest. They are never significant in any of the officer supply models presented in Tables 8 through 10. When both variables are omitted from the models, the dummy variables for the individual NRAs become statistically significant in most cases. It seems that the unmeasured tastes for the Navy contribute more to the success of recruiters and their productivity than do recruiters themselves. A better indicator for the propensity of college graduates to join the military would probably increase the explanatory power of the supply models. Youth Attitude Tracking Study surveys could be modified at relatively low cost to include college attendees to provide data on officer enlistment propensity.

There is no satisfactory explanation for the negative signs of the earned degrees variable. One might argue that a better measure would be the number of enrolled college students because those who graduate might move back to their hometowns before they join the military. However, recruiters are placed in areas where colleges are located and applications are primarily written during the time of college enrollment. The numbers of graduates and college seniors

differ probably only by a constant factor, and the number of degrees is likely to be a close approximation of enrollments. Thus, the models for applications presented in Table 8 should have positive signs for degrees, but they do not. As the number of earned degrees is of interest for officer supply, further analysis of this variable and its contribution to officer supply is warranted.

Will the steady decline of the youth population affect college enrollments and thereby increase officer recruiting problems? Harrington and Sum [Ref. 22:p. 20] show that, despite all population projections, the number of high school graduates enrolled in college in the fall following their graduation increased by 7.2 percent from 1982 to 1985. The authors argue that the increased enrollments depend on the growth of employment in private industry and increased benefits for higher education from available job alternatives. Harrington and Sum also show that the mean earnings for college-educated men are higher compared to those without college degrees. The difference in earnings jumped from 21 percent in 1973 to 57 percent in 1986. The same comparison for college-educated women shows an increase by nearly 25 percent. [Ref. 22:pp. 20-21] If these trends continue, the military available college graduate population should also increase. However, future graduates may expect higher returns than previous graduates from their future occupations.

The situation for Hispanic graduates seems even better. College enrollment after graduation from high school for this group increased by 7.9 percent from 1982 to 1986, which is above the increase in total enrollment. Therefore, their chance to be recruited has increased, while college enrollments for blacks increased by only 5.9 percent, making it relatively harder for them to be recruited. [Ref. 22:p. 20] Coefficient estimates for accessions (in Table 10, model 2, column 2) support this assumption. Overall, however, due to the decreasing defense budget, the military might not be able to compete sufficiently for these college graduates in the future.

Nonetheless, Uchitelle [Ref. 23] reports that recent studies found an increasing surplus of college graduates. While in prior years about 50 percent continued education after graduating from high school, this proportion has risen to almost 59 percent. Today, college graduates apply for jobs usually occupied by high school graduates. In light of this situation, officer recruiting--in general--might not become so difficult in the future.

An unexpected finding in this thesis was the inadequate results from estimating supply models for specific officer occupational specialties. Some problems were anticipated as a consequence of the unequal distribution of earned college degrees. However, further studies are needed to examine the behavior of the variables included in the models. This is

particularly important because the models for nuclear officers are based on 112 observations, as Tables 16-18 show, which is just two observations less than that used for the entire officer supply models. Nevertheless, the estimated nuclear officer models are not particularly robust.

In general, the data used for this thesis are applicable to describe a supply model for the total number of applications and accessions, but they are not adequate for a detailed investigation of the supply for specific occupational specialties. Furthermore, these data do not support the belief that new contracts are the correct measure for officer supply.

APPENDIX

TABLE 16

COEFFICIENT ESTIMATES OF SUPPLY MODELS FOR NUCLEAR OFFICERS USING APPLICATIONS[1]

VARIABLE	MODEL 1. APPLICAT	MODEL 2. APPLICAT	MODEL 3. APPRATE[b]
CONSTANT	170.806 (1.274)	20.289 (.141)	.039 (2.580)
UNEMPL	-5.789 (-2.261)	-5.073 (-1.988)	-.00111 (-2.649)
WAGE	-20.444 (-3.363)	-7.408 (-.982)	-.003 (-2.688)
RECRS	2.074 (.270)	1.853 (.246)	.00002 (.014)
GOAL	-7.526 (-.238)	-8.755 (-.282)	.0009 (.723)
DEGREE	.242 (.522)	.320 (.687)	.00007 (.921)
POP29	5.688 (3.298)	N/I	N/I
BLK29	N/I	-1.063 (-1.389)	N/I
HSP29	N/I	-1.200 (-1.795)	N/I
WH29	N/I	9.383 (4.023)	N/I
NRA3	-8.043 (-.672)	-3.253 (-.272)	-.0005 (-1.189)
NRA4	-1.757 (-.177)	-1.932 (-.198)	.0006 (1.208)
NRA5	- 3.775 (-1.490)	-2.266 (-.890)	-.0004 (-.991)

TABLE 16 (Continued)

NRA7	-9.957 (-.536)	-5.520 (-.302)	-.0003 (-.696)
NRA8	-3.166 (-.363)	-.749 (-.087)	.0003 (.610)
YEAR87	-.695 (-.081)	.006 (.001)	-.0006 (-2.173)
YEAR88	-1.450 (-.170)	-.805 (-.096)	-.0008 (-3.122)
NUMBER OF OBS.	112	112	112
R^2 - ADJUSTED	.32	.35	.31
F-STATISTIC	5.022	4.926	5.233

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, GOAL, and DEGREE are divided by the military available population.
N/I = not included.

TABLE 17

COEFFICIENT ESTIMATES OF SUPPLY MODELS FOR NUCLEAR OFFICERS USING CONTRACTS[a]

VARIABLE	MODEL 1. CONTRACT	MODEL 2. CONTRACT	MODEL 3. CONRATE[b]
CONSTANT	88.075 (.842)	-50.059 (-.454)	.021 (2.532)
UNEMPL	-2.637 (-1.320)	-1.979 (-1.009)	-.00049 (-1.435)
WAGE	-14.523 (-3.064)	-2.721 (-.470)	-.002 (-2.323)
RECRS	6.546 (1.093)	6.330 (1.094)	.001 (.995)

TABLE 17 (Continued)

GOALS	-2.643 (-.107)	-3.751 (-.158)	-.0004 (-.402)
DEGREE	.171 (.473)	.246 (.689)	.00004 (.699)
POP29	4.565 (3.406)	N/I	N/I
BLK29	N/I	-1.008 (-1.714)	N/I
HSP29	N/I	-1.135 (-2.210)	N/I
WH29	N/I	8.130 (4.536)	N/I
NRA3	-2.586 (-.277)	1.750 (.191)	-.0003 (-.942)
NRA4	1.013 (.131)	.826 (.110)	.0003 (.919)
NRA5	-4.201 (-2.126)	-2.843 (-1.453)	-.0006 (-1.947)
NRA7	-2.984 (-.206)	1.050 (.075)	-.0004 (-.915)
NRA8	-1.371 (-.201)	.772 (.117)	.000008 (.019)
YEAR87	-.638 (-.096)	-.001 (-.000)	-.00006 (-.259)
YEAR88	-.840 (-.126)	-.247 (-.039)	-.0002 (-.726)
NUMBER OF OBS.	112	112	112
R^2 - ADJUSTED	.23	.28	.18
F-STATISTIC	3.590	3.935	3.058

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, GOAL, and DEGREE are divided by the military available population.
N/I = not included.

TABLE 18

COEFFICIENT ESTIMATES OF
SUPPLY MODELS FOR NUCLEAR OFFICERS
USING ACCESSIONS[a]

VARIABLE	MODEL 1. ACCESS	MODEL 2. ACCESS	MODEL 3. ACCRATE[b]
CONSTANT	75.434 (.708)	-60.992 (-.541)	.020 (2.323)
UNEMPL	-3.031 (-1.490)	-2.375 (-1.184)	-.0006 (-1.624)
WAGE	-13.565 (-2.808)	-1.836 (-.310)	-.002 (-2.158)
RECRS	5.132 (.841)	4.926 (.832)	.0007 (.707)
GOAL	.312 (.012)	-.759 (-.031)	-.00009 (-.081)
DEGREE	.195 (.529)	.262 (.716)	.00005 (.748)
POP29	4.217 (3.088)	N/I	N/I
BLK29	N/I	-1.046 (-1.739)	N/I
HSP29	N/I	-1.109 (-2.111)	N/I
WH29	N/I	7.712 (4.206)	N/I
NRA3	-1.857 (-.195)	2.447 (.261)	-.0003 (-.838)
NRA4	1.550 (.197)	1.386 (.181)	.0004 (.958)
NRA5	-3.340 (-1.667)	-2.039 (-1.019)	-.0005 (-1.581)
NRA7	-1.759 (-.042)	2.206 (.153)	-.0003 (-.712)

TABLE 18 (Continued)

NRA8	-.291 (-.042)	1.810 (.268)	.0001 (.256)
YEAR87	-1.270 (-.187)	-.650 (-.098)	-.0001 (-.555)
YEAR88	-1.210 (-.179)	-.634 (-.096)	-.0002 (-.841)
NUMBER OF OBS.	112	112	112
R^2 - ADJUSTED	.21	.26	.19
F-STATISTIC	3.337	3.622	3.109

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, GOAL, and DEGREE are divided by the military available population.
N/I = not included.

TABLE 19

COEFFICIENT ESTIMATES OF SUPPLY MODEL FOR THE NURSE CORPS USING APPLICATIONS[a]

VARIABLE	MODEL 1. APPLICAT	MODEL 2. APPLICAT	MODEL 3. APPRATE[b]
CONSTANT	45.653 (.846)	8.310 (.076)	.037 (3.689)
UNEMPL	-3.231 (-.495)	-3.578 (-.520)	.0001 (.169)
WAGE	-15.006 (-2.479)	-10.153 (-1.114)	-.003 (-3.412)
RECRS	-3.182 (-1.336)	-3.282 (-1.313)	-.00008 (-.242)
GOAL	-1.664 (-1.106)	-1.663 (-1.052)	-.0002 (-.723)
DEGREE	-2.534 (-1.163)	-2.290 (-.937)	-.00008 (-.253)

TABLE 19 (Continued)

POP29	11.763 (4.647)	N/I	N/I
BLK29	N/I	1.705 (1.492)	N/I
HSP29	N/I	-.582 (-.382)	N/I
WH29	N/I	10.029 (2.776)	N/I
NRA3	-11.175 (-2.314)	-10.642 (-1.952)	-.0009 (-1.667)
NRA4	-11.506 (-3.791)	-10.569 (-3.135)	-.002 (-3.251)
NRA5	-15.610 (-4.828)	-13.880 (-3.325)	-.002 (-4.439)
YEAR87	-3.314 (-1.040)	-3.585 (-1.068)	-.0009 (-1.497)
YEAR88	-6.115 (-2.262)	-6.572 (-2.313)	-.001 (-2.036)
NUMBER OF OBS.	59	59	59
R^2 - ADJUSTED	.54	.49	.44
F-STATISTIC	7.146	5.317	5.691

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, GOAL, and DEGREE are divided by the military available population.
N/I = not included.

TABLE 20

COEFFICIENT ESTIMATES OF
SUPPLY MODELS FOR THE NURSE CORPS
USING CONTRACTS[a]

VARIABLE	MODEL 1. CONTRACT	MODEL 2. CONTRACT	MODEL 3. CONRATE[b]
CONSTANT	25.465 (.484)	-4.422 (-.041)	.029 (3.018)
UNEMPL	-4.668 (-.734)	-5.040 (-.753)	-.0002 (-.184)
WAGE	-11.143 (-1.889)	-6.984 (-.787)	-.003 (-2.800)
RECRS	-3.079 (-1.335)	-3.186 (-1.310)	.0001 (-.418)
GOAL	-1.345 (-.917)	-1.345 (-.874)	-.0001 (-.423)
DEGREE	-2.736 (-1.288)	-2.572 (-1.081)	-.0001 (-.483)
POP29	10.336 (4.189)	N/I	N/I
BLK29	N/I	1.447 (1.302)	N/I
HSP29	N/I	-.461 (-.311)	N/I
WH29	N/I	8.714 (2.479)	N/I
NRA3	-9.993 (-2.123)	-9.611 (-1.811)	-.0008 (-1.520)
NRA4	-9.307 (-3.146)	-8.528 (-2.600)	-.001 (-2.620)
NRA5	-13.183 (-4.184)	-11.748 (-2.892)	-.002 (-3.882)
YEAR87	-2.486 (-.801)	-2.722 (-.833)	-.0006 (-1.087)

TABLE 20 (Continued)

YEAR88	-4.464 (-1.694)	-4.875 (-1.763)	-.0006 (-1.377)
NUMBER OF OBS.	59	59	59
R^2 - ADJUSTED	.43	.38	.32
F-STATISTIC	4.991	3.683	3.776

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, GOAL, and DEGREE are divided by the military available population.
N/I = not included.

TABLE 21

COEFFICIENT ESTIMATES OF SUPPLY MODELS FOR THE NURSE CORPS USING ACCESSIONS[a]

VARIABLE	MODEL 1. ACCESS	MODEL 2. ACCESS	MODEL 3. ACCRATE[b]
CONSTANT	28.029 (.599)	42.172 (.443)	.026 (3.001)
UNEMPL	-4.919 (-.869)	-5.592 (-.938)	-.0006 (-.729)
WAGE	-10.850 (-2.066)	-10.029 (-1.270)	-.002 (-2.798)
RECRS	-1.683 (-.814)	-1.785 (-.824)	-.00007 (-.229)
GOAL	-1.057 (-.810)	-1.089 (-.795)	-.00008 (-.376)
DEGREE	-2.336 (-1.236)	-2.468 (-1.165)	-.0002 (-.800)
POP29	9.202 (4.190)	N/I	N/I

TABLE 21 (Continued)

BLK29	N/I	1.191 (1.203)	N/I
HSP29	N/I	.214 (.162)	N/I
WH29	N/I	6.662 (2.128)	N/I
NRA3	-5.669 (-1.353)	-6.169 (-1.306)	-.0004 (-.920)
NRA4	-5.470 (-2.077)	-5.113 (-1.750)	-.0008 (-1.698)
NRA5	-9.296 (-3.314)	-8.944 (-2.472)	-.002 (-3.268)
YEAR87	-2.329 (-.843)	-2.393 (-.822)	-.0005 (-.925)
YEAR88	-3.580 (-1.527)	-3.325 (-1.553)	-.0005 (-1.265)
NUMBER OF OBS.	59	59	59
R^2 - ADJUSTED	.34	.27	.27
F-STATISTIC	3.696	2.680	3.141

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, GOAL, and DEGREE are divided by the military available population.

N/I = not included.

TABLE 22

COEFFICIENT ESTIMATES OF SUPPLY MODEL FOR MEDICAL OFFICERS USING APPLICATIONS[a]

VARIABLE	MODEL 1. APPLICAT	MODEL 2. APPLICAT	MODEL 3. APPRATE[b]
CONSTANT	-9.833 (-.174)	-360.641 (-2.906)	-.002 (-.224)
UNEMPL	-5.309 (-1.720)	-2.860 (-.979)	-.0007 (-1.497)
WAGE	1.423 (.384)	24.776 (3.021)	.0004 (.061)
RECRS	-2.479 (-.788)	-1.945 (-.697)	-.00002 (-.032)
GOAL	-5.582 (-.775)	-1.772 (-.272)	.0005 (.688)
DEGREE	-3.574 (-1.843)	-1.192 (-.611)	-.0005 (-1.819)
POP29	4.707 (1.614)	N/I	N/I
BLK29	N/I	1.239 (1.587)	N/I
HSP29	N/I	-4.322 (-3.047)	N/I
WH29	N/I	13.434 (3.423)	N/I
NRA3	-7.577 (-1.282)	2.136 (.346)	-.0001 (-.377)
NRA4	-5.489 (-1.459)	-1.232 (-.329)	-.0004 (-1.045)
NRA5	-5.551 (-1.267)	3.001 (.610)	-.0004 (-.860)
NRA8	-7.354 (-1.883)	-4.355 (-1.263)	-.0005 (-.797)

TABLE 22 (Continued)

YEAR87	-3.910 (-3.407)	-5.186 (-4.743)	-.0006 (-3.389)
YEAR88	1.159 (.241)	-2.568 (-.581)	-.0006 (-1.006)
NUMBER OF OBS.	40	40	40
R^2 - ADJUSTED	.28	.44	.29
F-STATISTIC	2.266	3.154	2.463

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, GOAL, and DEGREE are divided by the military available population.
N/I = not included.

TABLE 23

COEFFICIENT ESTIMATES OF SUPPLY MODELS FOR MEDICAL OFFICERS USING CONTRACTS[a]

VARIABLE	MODEL 1. CONTRACT	MODEL 2. CONTRACT	MODEL 3. CONRATE[b]
CONSTANT	-52.416 (-1.125)	-309.702 (-2.866)	-.004 (-.777)
UNEMPL	-2.462 (-.965)	-.810 (-.319)	-.0005 (-1.270)
WAGE	1.820 (.594)	19.941 (2.792)	.0004 (.790)
RECRS	1.115 (.429)	1.487 (.612)	.0002 (.605)
GOAL	-1.280 (-.215)	1.508 (.266)	.00008 (.149)
DEGREE	-1.072 (-.669)	.349 (.205)	-.0003 (-1.322)
POP29	3.942 (1.635)	N/I	N/I

TABLE 23 (Continued)

BLK29	N/I	.699 (1.028)	N/I
HSP29	N/I	-3.215 (-2.603)	N/I
WH29	N/I	10.019 (2.931)	N/I
NRA3	-1.354 (-.277)	5.429 (1.010)	-.0001 (-.587)
NRA4	-1.337 (-.430)	1.293 (.397)	-.0003 (-.779)
NRA5	-.065 (-.018)	5.533 (1.292)	-.0001 (-.291)
NRA8	-6.269 (-2.034)	-3.539 (-1.179)	-.0004 (-.836)
YEAR87	-1.930 (-2.034)	-2.959 (-3.108)	-.0003 (-2.084)
YEAR88	-.841 (-.212)	-3.702 (-.962)	-.0003 (-.694)
NUMBER OF OBS.	40	40	40
R^2 - ADJUSTED	.13	.24	.12
F-STATISTIC	1.493	1.904	1.483

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, GOAL, and DEGREE are divided by the military available population.
N/I = not included.

TABLE 24

COEFFICIENT ESTIMATES OF
SUPPLY MODELS FOR MEDICAL OFFICERS
USING ACCESSIONS[a]

VARIABLE	MODEL 1. ACCESS	MODEL 2. ACCESS	MODEL 3. ACCRATE[b]
CONSTANT	-18.904 (-.479)	-220.922 (-2.424)	-.004 (-.910)
UNEMPL	-.736 (-.341)	.714 (.333)	-.00003 (-.083)
WAGE	1.616 (.624)	16.313 (2.708)	.0003 (.781)
RECRS	1.238 (.563)	1.546 (.754)	.0003 (.898)
GOAL	-3.799 (-.753)	-1.516 (-.317)	.00004 (.076)
DEGREE	-1.094 (-.807)	-.339 (-.237)	-.0002 (-1.104)
POP29	1.804 (.884)	N/I	N/I
BLK29	N/I	.011 (.019)	N/I
HSP29	N/I	-2.492 (-2.392)	N/I
WH29	N/I	6.785 (2.354)	N/I
NRA3	-2.765 (-.668)	2.389 (.527)	-.00006 (-.274)
NRA4	-2.437 (-.925)	-1.126 (-.409)	-.0003 (-1.005)
NRA5	-.802 (-.262)	2.584 (-1.644)	-.00001 (-.033)
NRA8	-3.549 (-1.299)	-1.644 (-.649)	-.0001 (-.228)

TABLE 24 (Continued)

YEAR87	-2.116 (-2.635)	-2.933 (-3.653)	-.0003 (-2.601)
YEAR88	1.512 (.450)	-.787 (-.242)	-.0002 (-.370)
NUMBER OF OBS.	40	40	40
R^2 - ADJUSTED	.15	.27	.16
F-STATISTIC	1.573	2.010	1.682

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, GOAL, and DEGREE are divided by the military available population.
N/I = not included.

TABLE 25

COEFFICIENT ESTIMATES OF SUPPLY MODELS FOR THE MEDICAL CORPS USING APPLICATIONS[a]

VARIABLE	MODEL 1. APPLICAT	MODEL 2. APPLICAT	MODEL 3. APPRATE[b]
CONSTANT	50.213 (.558)	-9.084 (-.071)	.058 (3.499)
UNEMPL	-1.189 (-.211)	.056 (.009)	.00002 (.020)
WAGE	-22.100 (-2.681)	-14.679 (-1.474)	-.005 (-2.986)
RECRS	-5.772 (-1.056)	-5.770 (-1.009)	-.0003 (-.295)
GOAL	-1.157 (-.195)	-.649 (-.104)	.0009 (.973)
DEGREE	-3.253 (-1.899)	-3.460 (-1.574)	-.00004 (-1.112)
POP29	-9.762 (-1.745)	N/I	N/I

TABLE 25 (Continued)

BLK29	N/I	.348 (.264)	N/I
HSP29	N/I	-.154 (-.122)	N/I
WH29	N/I	18.029 (3.733)	N/I
NRA3	-9.762 (-1.745)	-7.275 (-1.127)	-.0002 (-.226)
NRA4	-10.460 (-2.073)	-10.497 (-1.946)	-.001 (-1.437)
NRA5	-16.803 (-3.495)	-15.373 (-2.880)	-.003 (-2.857)
NRA7	-23.727 (-3.769)	-19.196 (-2.442)	-.003 (-3.005)
NRA8	-26.255 (-3.778)	-22.355 (-3.046)	-.002 (-1.582)
YEAR87	-15.395 (-3.575)	-15.373 (-3.407)	-.002 (-2.192)
YEAR88	-10.018 (-3.435)	-10.053 (-3.266)	-.001 (-2.808)
NUMBER OF OBS.	84	84	84
R^2 - ADJUSTED	.54	.50	.52
F-STATISTIC	8.603	6.537	8.445

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, GOAL, and DEGREE are divided by the military available population.
N/I = not included.

TABLE 26

COEFFICIENT ESTIMATES OF SUPPLY MODELS FOR THE MEDICAL CORPS USING CONTRACTS[a]

VARIABLE	MODEL 1. CONTRACT	MODEL 2. CONTRACT	MODEL 3. CONRATE[b]
CONSTANT	-19.922 (-.257)	-103.365 (-.950)	.026 (1.951)
UNEMPL	1.288 (-.265)	.433 (.083)	-.00005 (-.060)
WAGE	-10.688 (-1.508)	-2.963 (-.350)	-.003 (-1.928)
RECRS	-5.074 (-1.080)	-5.038 (1.037)	-.0002 (-.296)
GOAL	-1.648 (-.323)	-1.100 (-.208)	.0003 (.432)
DEGREE	-2.903 (-1.971)	-2.714 (-1.455)	-.0004 (-1.345)
POP29	15.169 (5.080)	N/I	N/I
BLK29	N/I	.200 (.178)	N/I
HSP29	N/I	-.690 (-.642)	N/I
WH29	N/I	15.667 (3.820)	N/I
NRA3	-9.302 (-1.933)	-6.188 (-1.116)	-.0006 (-.815)
NRA4	-10.129 (-2.334)	-9.949 (-2.172)	-.001 (-2.006)
NRA5	-14.163 (-3.426)	-12.555 (-2.697)	-.002 (-3.059)
NRA7	-19.178 (-3.544)	-13.651 (-2.045)	-.003 (-3.150)

TABLE 26 (Continued)

NRA8	-29.164 (-4.881)	-25.700 (-4.123)	-.003 (-2.538)
YEAR87	-11.063 (-2.988)	-10.962 (-2.861)	-.001 (-2.503)
YEAR88	-7.108 (-2.834)	-6.998 (-2.677)	-.0008 (-2.151)
NUMBER OF OBS.	84	84	84
R^2 - ADJUSTED	.45	.41	.39
F-STATISTIC	6.176	4.847	5.462

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, GOAL, and DEGREE are divided by the military available population.
N/I = not included.

TABLE 27

COEFFICIENT ESTIMATES OF SUPPLY MODELS FOR THE MEDICAL CORPS USING ACCESSIONS[a]

VARIABLE	MODEL 1. ACCESS	MODEL 2. ACCESS	MODEL 3. ACCRATE[b]
CONSTANT	-18.765 (-.299)	-80.832 (-.916)	.021 (1.873)
UNEMPL	-1.373 (-.349)	-.153 (-.036)	-.0002 (-.227)
WAGE	-8.803 (-1.533)	-2.793 (-.407)	-.002 (-1.896)
RECRS	-3.629 (-.953)	-3.610 (-.916)	-.0002 (-.254)
GOAL	-1.574 (-.381)	-1.150 (-.269)	.0003 (.413)
DEGREE	-2.729 (-2.287)	-2.683 (-1.774)	-.0004 (-1.735)

TABLE 27 (Continued)

POP29	12.726 (5.261)	N/I	N/I
BLK29	N/I	.174 (.191)	N/I
HSP29	N/I	-.428 (-.492)	N/I
WH29	N/I	12.899 (3.879)	N/I
NRA3	-6.326 (-1.623)	-3.944 (-.887)	-.0004 (-.629)
NRA4	-7.459 (-2.122)	-7.376 (-1.985)	-.001 (-1.765)
NRA5	-10.633 (-3.175)	-9.528 (-2.524)	-.002 (-2.867)
NRA7	-13.635 (-3.110)	-9.498 (-1.755)	-.002 (-2.655)
NRA8	-22.569 (-4.663)	-19.903 (-3.938)	-.002 (-2.287)
YEAR87	-9.143 (-3.048)	-9.081 (-2.923)	-.001 (-2.522)
YEAR88	-5.599 (-2.756)	-5.547 (-2.617)	-.0007 (-2.130)
NUMBER OF OBS.	84	84	84
R^2 - ADJUSTED	.44	.40	.37
F-STATISTIC	5.983	4.672	5.064

a. T-statistic in parentheses.
b. Dependent variable and variables RECRS, GOAL, and DEGREE are divided by the military available population.
N/I = not included.

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